Rheology and effective wall friction in wall-bounded dense granular flows

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ABSTRACT

In this work, we discuss contact dynamics, discrete element simulations of wall bounded shear flows of slightly polydisperse spheres under gravity. The flow configuration [1] is a periodic rectangular cuboid in which shear is imposed by a bottom rough wall moving at fixed velocity, while a pressure is applied at the top rough wall; two flat but frictional side walls provide lateral confinement.

Flow regimes differing by their strain localization features are observed. In particular, we show that shear can be localized (1) at the bottom or (2) at the top of the shear cell, or that (3) it can be even quite distributed in the vertical direction. As discussed elsewhere for a similar configuration [2], this behavior originates from the competition between dissipation at the side walls and dissipation in the bulk of the flow.

At first, we characterize the effective friction at side walls for each regime, and point out the importance of velocity fluctuations with respect to wall friction and slip. A simple scaling law linking the slip velocity, the granular temperature and the effective friction coefficient is presented.

Then, through an averaging technique which explicitly takes into account gradient effects [3], some relevant, coarse grained, continuum fields (solid fraction, velocity, stresses, velocity fluctuations) are obtained. They allow to discuss the co-linearity of the stress and rate of strain tensors, and the relevance of velocity fluctuations (i.e. granular temperature) for describing non-locality in granular flow.

REFERENCES

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